Claims

1. A data acquisition system for gathering geophysical data, said system comprising:

at least one data acquisition unit connectable to a plurality of sensors and being arranged, during use, to simultaneously gather geophysical data from the sensors, the or each data acquisition unit comprising time referencing means arranged to generate time reference data usable to control the time at which samples of geophysical data are taken; and

means for calculating spatial derivatives between simultaneous samples associated with adjacent sensors connected during use to the at least one data acquisition unit.

2. A data acquisition system as claimed in claim 1, wherein the time referencing means comprises a GPS receiver.

3. A data acquisition system as claimed in claim 1 or claim 2, wherein the time referencing means comprises an accurate oscillator.

4. A data acquisition system as claimed in claim 3, wherein the accurate oscillator comprises a precision oven controlled crystal oscillator, and the time referencing means further comprises a counter arranged to count signals generated by the oscillator.

5. A data acquisition system as claimed in claim 3 or claim 4, wherein the data acquisition unit is arranged to receive synchronisation signals useable to adjust the frequency of the oscillator and thereby adjust the times at which samples of geophysical data are taken so that the times at which samples of geophysical data are taken are synchronised with the times at which samples of geophysical data are taken in other data acquisition units.

6. A data acquisition system as claimed in any one of the preceding claims, wherein the data acquisition unit is arranged to receive and store programs for subsequent execution.

7. A data acquisition system as claimed in any one of the preceding claims, wherein the data acquisition unit is arranged to calculate an average sample value for a plurality of corresponding repeat sample values when a plurality of data gathering operations are carried out as part of a geophysical survey so as to reduce the effect of interference on the samples and reduce the quantity of data.

8. A data acquisition system as claimed in claim 7, wherein the data acquisition unit is arranged to compare repeat samples and to discard samples which differ by a predetermined amount from the majority of the repeat samples.

9. A data acquisition system as claimed in any one of the preceding claims, wherein the data acquisition unit is arranged to calculate an average sample value for a plurality of consecutive samples taken during a data gathering operation carried out as part of a geophysical survey so as to produce a representative sample for the consecutive samples.

10. A data acquisition system as claimed in any one of the preceding claims, wherein the data acquisition unit is arranged to estimate the amount of interference present at a survey site.

11. A data acquisition system as claimed in claim 10, wherein the amount of interference present is estimated by carrying out a first data gathering operation with an incident magnetic field of a first polarity so as to produce a first response, carrying out a second data gathering operation with an incident magnetic field of a second polarity so as to produce a second response, and calculating the sum of the first and second responses so as to cause the first and second responses to cancel out.

12. A data acquisition system as claimed in any one of the preceding claims, wherein the data acquisition unit is arranged to filter gathered geophysical data so as to remove periodic interference.

13. A data acquisition system as claimed in any one of the preceding claims, wherein

the data acquisition unit is arranged to convert gathered geophysical data into frequency domain using Fourier transform analysis.

14. A data acquisition system as claimed in any one of the preceding claims, wherein the data acquisition unit is arranged to generate a least one quality control indicator for use in assessing the quality of the gathered geophysical survey data.

15. A data acquisition system as claimed in claim 14, wherein the data acquisition unit is arranged to calculate a standard deviation value for the gathered geophysical survey data.

16. A data acquisition system as claimed in any one of the preceding claims, wherein the data acquisition unit is arranged to adjust the level of gain applied to gathered geophysical survey data based on an assessment of the magnitude of the gathered geophysical survey data.

17. A data acquisition system as claimed in any one of the preceding claims, wherein the data acquisition unit is arranged to downward extrapolate gathered geophysical survey data so as to enhance detail of a target located below the surface of a survey area.

18. A data acquisition system as claimed in any one of the preceding claims, wherein the data acquisition unit is connectable to an energy source, the data acquisition unit is arranged to gather energy source output data from the energy source, and the time referencing means is arranged so as to sample the gathered energy source output data.

19. A data acquisition system as claimed in claim 18, wherein the systyem is arranged to correct for variations in magnitude of the energy source output during a geophysical survey.

20. A data acquisition system as claimed in claim 14, wherein the system is arranged to correct for a variation in magnitude of the gathered geophysical data caused by a variation in power supplied to the energy source.

21. A data acquisition system as claimed in any one of the preceding claims, further comprising at least one interface arranged to facilitate transfer of geophysical data and/or programs to or from the data acquisition unit.

22. A data acquisition system as claimed in claim 21, wherein the data acquisition unit comprises a multi-tasking operating system.

23. A data acquisition system as claimed in claim 22, wherein the data acquisition unit is arranged to facilitate transfer of geophysical data from the data acquisition unit during a geophysical survey.

24. A data acquisition system as claimed in any one of claims 21 to 23, wherein the interface comprises an infra red interface, a serial interface and/or a network interface.

25. A data acquisition system as claimed in any one of the preceding claims, wherein the data acquisition unit is arranged to store a correction coefficient for each sensor connected during use to the data acquisition unit, each correction coefficient being used to correct for variations in sensor sensitivity.

26. A data acquisition system as claimed in any one of the preceding claims, further comprising display means arranged to provide information indicative of operation of the data acquisition unit to an operator.

27. A data acquisition system as claimed in any one of the preceding claims, wherein the data acquisition unit includes the means for calculating spatial derivatives.

28. A data acquisition system as claimed in any one of claims 1 to 26, wherein the means for calculating spatial derivatives is separate to the data acquisition unit.

29. A data acquisition system as claimed in claim 28, further including a portable computing device, the portable computing device including the means for calculating

spatial derivatives.

30. A data acquisition system as claimed in any one of the preceding claims, further comprising a plurality of data acquisition units as claimed in any one of the preceding claims.

31. A data acquisition system as claimed in any one of the preceding claims, further comprising:

at least one reference data acquisition unit, each reference data acquisition unit being connectable to at least one reference sensor and being arranged, during use, to gather geophysical data from the at least one reference sensor, and to take samples of the geophysical data gathered from the sensors;

wherein the means for calculating spatial derivatives between samples associated with adjacent sensors is arranged to calculate first spatial derivatives between at least some of the sensors and a reference sensor connected to the reference data acquisition unit during a first data gathering operation when the sensors are disposed in a first location, to calculate second spatial derivatives between at least some of the sensors and a reference sensor connected to the reference data acquisition unit during a second data gathering operation when the sensors are disposed in a second location, and to calculate a difference spatial derivative between the first and second spatial derivatives, each said difference spatial derivative being indicative of a spatial derivative between a sensor disposed in a first location and a sensor disposed in a second location.

32. A data acquisition system as claimed in claim 30 or claim 31, further comprising means for calculating an integral of the spatial derivatives.

33. A data acquisition system as claimed in any one of claims 30 to 32, further comprising an energy source arranged to generate and direct energy towards a sub-surface volume so as to cause a geophysical response and thereby cause generation of the geophysical signals.

34. A data acquisition system as claimed in claim 33, wherein the energy source

includes a transmitter and a transmitter loop.

35. A data acquisition system as claimed in claim 30 to 34, further comprising an energy source control unit connectable to the energy source and arranged to gather output data from the energy source, the energy source control unit comprising time referencing means arranged to generate time reference data usable to control the time at which samples of the energy source output data are taken and to associate the energy source output data with the time reference data.

36. A data acquisition system as claimed in claim 35, wherein the energy source control unit is a transmitter control unit arranged to control a transmitter so as to energise a transmitter loop in accordance with a predetermined frequency.

37. A data acquisition system as claimed in claim 35 or claim 36, wherein the energy source control unit includes the same components as the data acquisition unit so that the transmitter control unit is capable of carrying out the functions of the data acquisition unit and vice versa.

38. A method of acquiring geophysical data, said method including the steps of:

providing at least one data acquisition unit arranged to simultaneously gather geophysical data from a plurality of sensors connected in use to the at least one data acquisition unit;

connecting a plurality of sensors to the at least one data acquisition unit;

generating at the data acquisition unit time reference data usable to control the time at which gathering of samples of geophysical data are taken; and

calculating spatial derivatives between simultaneous samples associated with adjacent sensors connected during use to the at least one data acquisition unit.

39. A method of acquiring geophysical data as claimed in claim 38, further comprising the steps of:

providing at least one reference data acquisition unit arranged, during use, to gather geophysical data from the at least one reference sensor;

connecting each reference data acquisition unit to at least one reference sensor ;

calculating first spatial derivatives between at least some of the sensors connected to the data acquisition units and a reference sensor connected to the reference data acquisition unit during a first data gathering operation when the sensors are disposed in a first location;

calculating second spatial derivatives between at least some of the sensors connected to the data acquisition units and a reference sensor connected to the reference data acquisition unit during a second data gathering operation when the sensors are disposed in a second location; and

calculating a difference spatial derivative between the first and second spatial derivatives, each said difference spatial derivative being indicative of a spatial derivative between a sensor disposed in a first location and a sensor disposed in a second location.

40. A data acquisition system as claimed in claim 38 or claim 39, further comprising means for calculating an integral of the spatial derivatives.

41. A method as claimed in any one of claims 38 to 40, wherein the step of generating time reference data comprises the step of providing a GPS receiver.

42. A method as claimed in any one of claims 38 or claim 41, wherein the step of generating time reference data comprises the step of providing an oscillator.

43. A method as claimed in claim 42, wherein the oscillator comprises a precision oven controlled crystal oscillator, and the step of generating time reference data further comprises the step of providing a counter arranged to count signals generated by oscillator.

44. A method as claimed in claim 42 or claim 43, further comprising the step of facilitating reception at the data acquisition unit of synchronisation signals useable by the processing means to adjust the frequency of the oscillator and thereby adjust the time at which samples of geophysical data are taken so as to synchronise the time at which

samples of geophysical data are taken with the time at which samples of geophysical data are taken in other data acquisition units.

45. A method as claimed in any one of claims 38 to 44, further comprising the steps of receiving and storing programs at the data acquisition unit for subsequent execution by the processing means.

46. A method as claimed in any one of claims 38 to 45, further comprising the step of calculating an average sample value for a plurality of corresponding repeat sample values when a plurality of data gathering operations are carried out as part of a geophysical survey so as to reduce the effect of interference on the samples and reduce the quantity of data.

47. A method as claimed in any one of claims 38 to 46, further comprising the step of comparing repeat sample values and discarding samples which differ by a predetermined amount from the majority of the repeat sample values.

48. A method as claimed in any one of claims 38 to 47, further comprising the step of calculating an average sample value for a plurality of consecutive samples taken during a data gathering operation carried out as part of a geophysical survey so as to produce a representative sample for the consecutive samples.

49. A method as claimed in any one of claims 38 to 48, further comprising the step of estimating the amount of interference present at a survey site.

50. A method as claimed in claim 49, wherein the amount of interference present is estimated by carrying out a first data gathering operation with an incident magnetic field of a first polarity so as to produce a first response, carrying out a second data gathering operation with an incident magnetic field of a second polarity so as to produce a second response, and calculating the sum of the first and second responses so as to cause the first and second responses to cancel out.

51. A method as claimed in any one of claims 38 to 50, further comprising the step of filtering gathered geophysical data so as to remove periodic interference.

52. A method as claimed in any one of claims 38 to 51, further comprising the step of converting gathered geophysical data into frequency domain using Fourier transform analysis.

53. A method as claimed in any one of claims 38 to 52, further comprising the step of correcting for variations in magnitude of an energy source during a geophysical survey.

54. A method as claimed in claim 53, wherein the step of correcting for variations in magnitude includes the step of correcting for a variation in magnitude of the energy source caused by a variation in power supplied to the energy source.

55. A method as claimed in any one of claims 38 to 54, further comprising the step of generating a least one quality control indicator for use in assessing the quality of the gathered geophysical survey data.

56. A method as claimed in claim 55, further comprising the step of calculating a standard deviation value for the gathered geophysical survey data.

57. A method as claimed in any one of claims 38 to 56, further comprising the step of adjusting the level of gain applied to gathered geophysical survey data based on an assessment of the magnitude of the gathered geophysical survey data.

58. A method as claimed in any one of claims 38 to 57, further comprising the step of downward extrapolating gathered geophysical survey data so as to enhance detail of a target located below the surface of a survey area.

59. A method as claimed in any one of claims 38 to 58, wherein the method further comprising the step of facilitating transfer of processed geophysical data and/or programs to or from the data acquisition unit.

60. A method as claimed in any one of claims 38 to 59, further comprising the step of providing each data acquisition unit with display means for providing information indicative of operation of the data acquisition unit to an operator.

61. A system as claimed in claim 33, wherein the system is arranged to correct variations in the energy source using the reference data acquisition unit and associated reference sensor.

62. A method as claimed in claim 53, further comprising the step of correcting variations in the energy source using the reference data acquisition unit and associated reference sensor.